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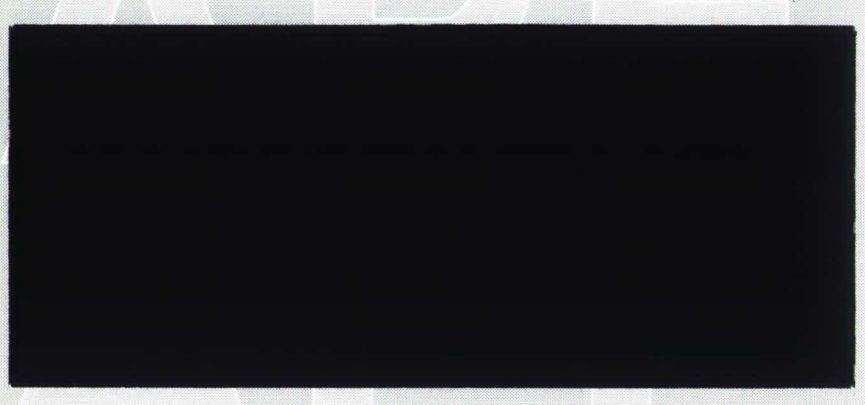

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Stress in software development: User representatives pay for user participation

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Stress in software development:
User representatives pay for user participation

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1 Introduction

1.1 Work situation in software development

Professional software development mainly takes place in project teams. These teams often have an interdisciplinary nature, especially when users of the future software product or their representatives are involved in the development process. In software development projects high cognitive, learning, and communication requirements are frequently present.

Regarding the amount of stress characteristic of software development Kumashiro, Kamada, and Miyake (1989) reported the pace of work and overtime in a sample of 104 software engineers. These two stressors resulted in higher overall stressor scores of these professionals than in other professional groups. Ivancevich, Napier, and Wetherbe (1983, 1985) described problems in communication, such as non receipt of relevant information, time pressure, and work overload as typical stressors in software

[1] This investigation was part of the project IPAS (a German acronym of "Interdisciplinary Project about the Work Situation in Software Development"). The project IPAS consists of a computer science part (University of Marburg: U. Bittner, W. Hesse, J. Schnath), a social science part (SPG Sozialwissenschaftliche Projektgruppe, Munich: F. Weltz & R. Ortmann), and a work psychology part (University of Giessen: F.C. Brodbeck, M. Frese, T. Heinbokel, S. Sonnentag, W. Stolte). It was supported by a grant from the Work and Technology Fund of the Ministry of Research and Technology of the Federal Republic of Germany (No. 01 HK 319). The author takes the responsibility for this publication. Special thanks are due to Felix C. Brodbeck and Jerilyn Lewter for their helpful comments on an earlier draft of this paper.

development. However, theses authors found that the work situation in software development was not any more stressful than was the case in other fields.

Other studies in the field of research and development came to similar conclusions. Engineers reported poorer quality equipment, more overtime, more difficulties with supervisors, and more stress in meeting deadlines than did managers and clerical workers (Turnage & Spielberger, 1991). Keenan and Newton (1985) identified the experience of wasted time and/or wasted effort and interpersonal conflicts as the major sources of stressors in engineers.

There are only a few studies examining the consequences of work stress for software professionals. However, it can be assumed that for these persons the relationships between stressors and strain variables are similar to those found in other professional groups (Weiss, 1983). Fujigaki and Mori (1993) examined members of software development projects. These authors reported correlations ranging from .27 to .53 between overwork and psychological strain measures (i.e. arousal or depression), as well as between overwork and cortisol measures.

1.2 User participation

One important discussion in the field of software engineering and software development concerns the involvement of users in the development process. The suggestions range from thinking about the users' needs and following guidelines for the interface design, to active participation of users in the project team (e.g. Grudin, 1991).

Advocates of the user participation approach claim that user involvement is necessary since software designers usually are not familiar with the tasks of the people who will work with the future software systems (Curtis, Krasner, & Iscoe, 1988). Additionally, software designers often do not have enough time to become familiar with the application domain of their products. It is assumed that users show a better acceptance of the product if they were involved in the development process (Baroudi, Olsen, &

Ives, 1986; Selig, 1986). Some authors have shown that user participation, especially rapid prototyping, contributed to a greater success of the software development project (e.g. Boehm, Gray, & Seewaldt, 1981; Strohm, 1991). However, Heinbokel, Frese, Stolte, Brodbeck, & Sonnentag (1993) reported a lower process quality in projects with user involvement than in projects without user involvement.

The previous discussion of user involvement focused on the impact of participation on the quality of the future software product. Little is known about the effect of user involvement on the members of the software development projects themselves, especially the users and their representatives. The question raises if working in a project with user involvement is more stressful than working in a project without user involvement. Since the experience of stress may have an impact on the engagement in the participation process and its outcome, it is also interesting to know whether there are professional groups in software development projects that are more effected by user involvement than are other groups. Therefore, in our study of software development projects we examined how user representatives perceived their work situations and how stress-related aspects of their work situations were associated with their psychological well-being.

2 Method of the study

2.1 Sample

The study was performed in 29 software development projects from 19 German and Swiss companies1. These projects produced software for various application domains, e.g. software for the administration of both small and large companies, for telephone and communication purposes, for banks and insurance companies, for traffic institutions, and for process control. Thirty-four percent of the projects were studied during the early phases of software development (e.g. requirement analysis and software design), 28 % during coding and testing, and 38 % during delivery and maintenance.

The mean project size was 10 members (s=4.8). An average of 74 % of the members in a given project participated in the study (s=26.3 %). Fourteen out of the 29 projects were projects with user involvement, 15 were projects without user involvement.

The total sample of the study included 200 persons. From 180 subjects questionnaire responses were obtained. Of the subjects, 62.1 % were systems analysts and programmers, 25.6 % team or sub-team leaders, 9.9 % user representatives, and 2.5 % had other, mostly administrative, tasks in the project. The average professional experience in software development projects was 5.7 years. Twenty-five percent of the subjects were female. The average age was 33 years.

2.2 Measures

2.2.1 Work situation

As measures of the work situation, perceived stressors and hours of overtime were assessed. Stressors were ascertained with a 20-item questionnaire scale developed by Frese (1988). With this scale, various sources of stressors were assessed: stressors in the work itself such as quantitative overload, stressors concerning performance and responsibility, stressors concerning lack of influence, stressors due to lack of career prospects, and stressors resulting from organizational policy. In the present study, Cronbach's alpha was .88 for this scale. Overtime was assessed by single questionnaire item.

2.2.2 Disturbances of psychological well-being

Disturbances of psychological well-being were ascertained with four scales: irritation/strain, psychosomatic complaints, lack of identification, and perceived pressure. The scale irritation/strain was comprised of 8 items (e.g. "I quickly get annoyed"), the scale psychosomatic complaints was comprised of 9 items, such as headaches or sleeping disturbances. Both scales were developed by Mohr (1986). Cronbach's alphas were .86

and .67, respectively. The remaining scales, lack of identification and perceived pressure, were two burnout factors identified by Sonnentag, Brodbeck, Heinbokel, and Stolte (1993). The lack of identification scale was comprised of 9 items (e.g. "I can identify myself with my tasks", reverse scored), the perceived pressure scale was comprised of 6 items (e.g. "My profession is a profession in which one is constantly overcharged"). Cronbach's alphas for these scales were .86 and .62, respectively.

2.2.3 User involvement

User involvement was measured in an interview with project managers or team leaders. They were asked whether user representatives participated in the software development project.

3 Results

3.1 Stressors and overtime in software development

In general, we found a medium to low level of stressors in software development projects. The most prominent stressors were those that concerned the work itself, such as quantitative overload ("I have too much work") and interruptions of the work process, for example by telephone calls. Quantitative overload was often experienced as time pressure. In contrast, low stressor scores were found for aspects concerning missing career prospects (e.g. "I have no opportunities for learning, qualification, and development").

Regarding the various professional groups (i.e. systems analysts and programmers vs. team leaders vs. user representatives), it was found that user representatives had the highest stressor scores, while systems analysts and programmers had the lowest scores. Team leaders were in a medium position ($F(2,159)=3.97$; $p<.05$). Similar results were found with regard to hours of overtime. Systems analysts and programmers were found

to work 2.9 hours overtime per week, team leaders 5.7 hours, and user representatives 5.3 hours ($F(2,160)=8.20$; $p<.001$).

There are two major explanations for the finding of the highest stressor scores in user representatives. First, it is possible that projects with user involvement are generally more stressful than projects without user representatives. Second, one might argue that the job of user representatives differs from that of the other software professionals and that it incorporates more stressors.

In a 2x2 analysis of variance, stressors and overtime of systems analysts/programmers vs. team leaders in projects with vs. projects without user involvement were compared. The analyses showed that there was no effect of user involvement on stressor scores ($F(,140)=1.61$; n.s.) and only a marginally significant effect of user involvement on hours of overtime ($F(1,142)=3.83$; $p=.052$). Project leaders had marginally higher stressor scores and performed more hours of overtime than systems analysts and programmers ($F(1,140)=2.90$; $p=.091$ for stressors and $F(1,142)=12.92$; $p<.001$ for overtime). Therefore it can be assumed that the high stressor scores of user representatives are a result of their specific jobs and their function in the project, and are not due to a more stressful work situation being characteristic of user involvement projects in general.

What are the reasons for the higher perceived stressor scores of user representatives? User representatives have a difficult task in software development. They work in a position sandwiched between the future users and those who do the design and programming of the system. They are supposed to watch out for the interests of the users in the project team. But there they are confronted with technical and other constraints that they, in turn, have to make plausible to the users again. While user representatives work in the software development project they are often not relieved of their duties in the user department, which can be seen as an additional source of stress. This idea is supported by the results of the recent job analyses indicating that user representatives

spent about 20 % of their working time in the user department (Brodbeck, in press; see also Beck, 1993).

3.2 Relationship between stressors, overtime and disturbances of well-being

Table 1 shows the correlation for the total sample between stressors, hours of overtime, and disturbances of psychological well-being. It becomes obvious that stressors were related to high irritation/strain, psychosomatic complaints, lack of identification, and perceived pressure. Hours of overtime were positively correlated with irritation/strain and perceived pressure, but negatively with lack of identification. This means that persons who worked many hours of overtime showed a higher identification with their job.

Table 1: Correlations between stressors, overtime and disturbances of psychological well-being

Disturbances of Well-being	**Stressors**	
Overtime		
irritation/strain	.37**	.25**
psychosomatic complaints	.38**	.12
lack of identification	.29**	-.19**
perceived pressure	.64**	.23**

Note

* $p < .05$ ** $p < .01$ N=166-168

In order to test if the relationship between stressors, overtime, and well-being differed across the various professional groups, moderated regression analyses were performed (Cohen & Cohen, 1975). The question of interest was whether or not being a user

representative had any impact on the relationships between the various variables. The criteria in the analyses were irritation/strain, psychosomatic complaints, lack of identification, and perceived pressure. The predictors were stressors and overtime, function in the project (systems analyst/programmer and team leader vs. user representative), and the interaction between stressors and function, and overtime and function. In the first step, stressors and function, and overtime and function, respectively, were entered into the equation. In the second step the interaction term was entered. The results of the analyses are shown in Table 2.

Table 2: Effects of being a user representative on the relationship between stressors, overtime, and disturbances of psychological well-being

Criterion	**Predictor**	**R^2**	**Change of R^2**	**Beta**
irritation/ strain	stressors	.16**	.030*	2.38*
	overtime	.08**	.023*	.28*
psychosomatic complaints	stressors	.14**	.002	.65
	overtime	.03	.014	.22
lack of identification	stressors	.11**	.023*	-2.03*
	overtime	.05*	.000	.02
perceived pressure	stressors	.42**	.020*	2.35*
	overtime	.13**	.055**	3.15**

Note

Beta indicates beta of interaction term (stressor x function) and (overtime x function) resp.

* $p<.05$ ** $p<.01$ N=161-163

It can be seen that in five out of eight analyses the R2 increased significantly when the interaction term was entered into the equation. This indicates that an individual's function in the project had an impact on the relationship between both stressors or

overtime and disturbances of psychological well-being. Regarding for example, the effect of stressors on irritation/strain, it can be seen that the sign of beta weight for the interaction term is positive. This indicates that being a user representative enhanced the relationship between stressors and irritation/strain. The same result was found for the relation between overtime and irritation/strain, stressors and perceived pressure, as well as overtime and perceived pressure. Thus, there was a stronger relationship between theses variables for user representatives than for systems analysts/programmers or team leaders.

However, the opposite effect was found for the relationship between stressors and lack of identification. Being a systems analyst/programmer or a team leader enhanced the relationship between stressors and this burnout factor. There was no association between stressors and lack of identification for user representatives.

Again, these moderator effects could not only be due to the special jobs of user representatives, but also to general difficulties in projects having user involvement. Therefore, in further analyses we controlled for whether or not subjects worked in a project having user involvement. However, all results remained stable. From theses analyses it can be concluded that the effect of being a user representative on the relationship between work situation and well-being can not be explained by the difficult conditions being present in user involvement projects, but by the situation of the user representatives themselves.

In summary, the analyses showed that the unfavourable situation of user representatives was twofold. First, they experienced the highest level of stressors and a relatively high level of overtime. Second, for user representatives a stressful work situation and hours of overtime were more often accompanied by a low psychological well-being.

4. Conclusion

The results of the study suggest that user representatives pay a high price for user involvement. Reasons for this can be seen in the situation of the user representatives themselves and in the attitudes of the other team members. Concerning the situation of the user representatives themselves, there are probably at least two factors that contribute to the strong relationship between stress and disturbances of well-being. First, user representatives have a shorter professional experience in software development than do the other groups. This suggests that they do not possess enough competencies to deal with the stressors and difficulties that occur in software development projects. Second - without having examined it empirically - we assume that user representatives get less social support than the other professional groups in software development. Studies have shown that social support has a buffering effect on the relationship between stressors and psychological strain (e.g. Frese & Semmer, 1991; House, 1981). The major reason for the possible lower level of social support in user representatives is seen as being due to their sandwich position between development project and user department, the often conflicting interests, and the frequent switch between both organizational units. Therefore, it is plausible that user representatives do not have the necessary resources to cope with their stressful situations in the development project.

Additionally, the attitude of other team members may contribute to the unfavourable situation of user representatives. In our study we asked members of software development projects to tell us what characterized a very good software professional (Sonnentag, 1992; Sonnentag, in press). Aspects of exceptional competence that concerned users and the application domain were significantly more often reported by user representatives. This shows that mainly user representatives feel responsible for user involvement.

In general, participation should improve the quality of working life of the users. However, this study has shown that participatory approaches have their own pitfalls.

Therefore, in future discussions of participatory concepts it is necessary not only to ask how a good product quality can be achieved. It should also be kept in mind that the well-being of those who are involved in the development process must be protected. One consequence could be to give user representatives adequate training for their job and to provide them with social support, for example by involving at least two user representatives together in a software development project.

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